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COMPONENT PARTS OF THE ZIL-131

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## TECHNICAL TRANSLATION

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**TECHNICAL TRANSLATION**

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**Component Parts of the ZIL-131**

by

**Engineer G. Armand**

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The journal "Avtomobil'nyy Transport" (No. 1, 1967) represented a general description of the ZIL-131 mechanism and provided information about its basic technical and operational qualities. Being very similar to the ZIL-130 in the layout of many components and assemblies, the ZIL-131 is quite different in design. In this regard the readers of this journal have expressed interest in the design features of individual mechanisms of the ZIL-131.

A description is presented below of certain components of the ZIL-131 which has features resulting from the basic purpose of this vehicle, in which permit its operation on all types of roads and unimproved tracks.

#### Design Features of the Power Plant

The power plant includes the engine, clutch and transmission.

The ZIL-131 engine is similar to that of the ZIL-130 in its parameters and the design of basic mechanisms. It does however have a number of significant differences related to the purpose of the vehicle itself, which is designed for operation on all types of highways and unimproved roads. The design of the crank case has been changed for better adaptation of the engine to operation on a steep long grades and side tilts of the vehicle, and also

for getting over deep fords. It has a shaft into which a stationary oil pan is permanently immersed.

The crankcase ventilation system is designed so that it may be disconnected at any time. This is necessary so that an overpressure may be created in the crankcase to prevent water getting into it during fording of streams.

The water pump and fan and the cooling system have a separate drive mechanism which permits disconnecting the fan during fording of streams, thereby reducing tension of the drive belt. The fan blades are thus prevented from striking the water, while the water pump and also the power steering pump and the brake system compressor, which feeds the system for controlling air pressure in the tires, continue operating.

The radiator is four-row, it has a large cooling area and is equipped with a condensation tank.

In order to compensate for the temperature stresses in the more intensely heated components and at the same time to avoid disruption of the coupling seals, a sectional exhaust outlet is mounted on the engine (it is a one-piece outlet on the ZIL-130 engine).

A heavy-duty foam-oil filter with three-step cleaning of the air is used in the ZIL-131 engine, which permits prolonged driving over dusty field and dirt roads, without causing increased engine wear. Air enters the compressor through this same filter.

The fuel system is equipped with a fuel pump having a capacity of 130 l/min. Such a large capacity in the fuel pump permits the engine to operate smoothly at high temperatures of the surrounding air, when vapor locks may occur in the fuel lines.

The fuel tanks are interconnected by an equalizing fuel line. The tank valves are installed in a separate sealed housing, linked to the atmosphere through a special pipe which is extended higher than the maximum possible fording level.

The yoke release of the clutch assembly axels is sealed. This prevents water getting into the housing. When moving over dry land, the clutch is ventilated through an outlet installed in the housing cover. A pin of much smaller diameter than that of the outlet itself is inserted into it for self-cleaning. During fording of streams, the outlet is closed with an end plug which is located in a threaded socket on the housing cover of the front axel reducing gear during normal operation of the vehicle.

The uniqueness of the transmission is that the housing ventilation system through a breather is connected to a pipe extended higher than the maximum possible fording level.

All external couplings of the ZIL-131 power plant are sealed with a special VTU MKhP 3336-52 sealing paste, whereas all couplings of the ZIL-130 power plant have ordinary gaskets without paste.

The electrical system of the ZIL-131 engine is shielded and its instruments are water and air tight.

A. Zubarev

#### The Drive Shaft

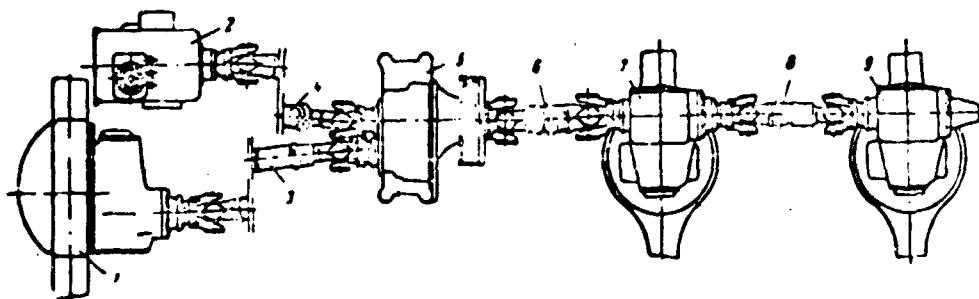
The drive shaft of the ZIL-131 compared to that of the ZIL-157K has a number of significant differences which permit increasing its operational capability.

An air tight splined coupling with centering along two diameters, which increases its lifetime, is used in all drive shafts.

A two-sided rubber self-moving seal is used for more reliable protection of the universal joints from water and dirt, and also to facilitate keeping grease in the drive shaft bearing.

The drive shaft of the ZIL-131 (See the sketch) consists of 4 shafts - the main shaft (4) which connects the transmission (2) with the transfer case (5); the front axel shaft (3) which connects the transfer case to the front axel reducing gear (1); the shaft (6) of the front rear axel which connects the transfer case to the reducing gear of the front rear axel (?); and the rear axel shaft (8)

which connects the reducing gears of the front rear and rear (9) axels. All drive shafts are identical in design, except that the shaft of the front rear axel is larger.



Drive Shaft of the ZIL-131:  
1-front axel; 2-transmission; 3-front axle drive shaft;  
4-main drive shaft; 5-transfer case; 6-front rear axle drive  
shaft; 7-front rear axel; 8-rear axle drive shaft; 9- rear  
axel.

An air tight splined coupling with evoluted splines and two-diameter centering is used in the drive shafts of the ZIL-131. The splines of the slip yoke are centered by their outer diameter along the outer diameter of the splines on the bushing. The splines of the bushing itself are at the same time centered by their inner diameter along the smooth cylindrical collar of the slip yoke. It is thus possible to obtain a long length of centering surfaces on the short length of the slip yoke splines. The slip yoke has a large inner cavity. This cavity serves as a "reervoir" for the lubricant and makes it possible to avoid high pressures inside the splined coupling and at the same time to protect its seals from damage.

The lubricant is placed inside the inner cavity of the spline bushing and is kept from leaking out by a plug screwed into the splined bushing, and also by rubber and felt seals.

When the slip yoke moves, the volume of the space behind it changes due to a change of the drive shaft during operation of the vehicle, which also causes a change in pressure in this part of the splined coupling. The air inside compresses the lubricant, thus feeding it to the operating surfaces of the splines.

The lubricant is changed every 20-25 thousand km. The splined coupling must be disassembled and flushed out in order to change the lubricant and fresh US-1 lubricant is put into the housing of the splined bushing. 400 g of lubricant is put into the splined bushing of the front rear axel drive shaft, and 250 g each is put into the bushings of the remaining shafts<sup>1</sup>.

The layout of all drive shaft universal joints is identical. Each universal joint consists of a yoke, a bushing flange and a center cross mounted on needle bearings. The presence of a fixed, two-sided self-moveable rubber seal in the bearing increases the reliability of the universal joint.

When adding lubricant to the center cross bearings, it should be forced out of the valve after 5-8 strokes of the grease gun handle, and after 45-50 strokes if there is no lubricant in the universal joint.

All drive shafts are dynamically balanced at the factory. The drive shafts of the front and front rear axels are balanced by welding balancing plates on both ends of the shaft.

The main and front rear axel drive shafts are balanced on the side of the fixed bushing by welding balancing plates on the shaft, and on the side of the slip yoke - by screwing the balancing plates to the ends of the bushing plugs. Disruption of the drive shaft balance causes the vehicle to vibrate and decreases the service life of the drive shaft itself, as well as the assemblies coupled to it. Disruption of drive shaft balance is caused by the components of the universal joint and slip coupling spline wearing out. Therefore, the drive shaft should be replaced with a new one when too much play develops in the universal joint and slip coupling. Replacing new parts for worn out ones in the drive shaft also unbalances it. The drive shaft must be  
1. Increasing the quantity of lubricant or adding it through the plug in the spline bushing may damage the seals of the splined coupling and rupture its air tightness.

dynamically rebalanced after any parts have been replaced in it. The permissible amount of unbalance in the front rear axle drive shaft is 100 gcm, and 70 gcm for the remaining shafts. After the universal joint of the front rear axle and main drive shafts has been disassembled, the balancing plates screwed to the ends of the bushing plugs should be replaced in their previous positions according to the markings noted.

L. Tarasov

#### Features of the Suspension System Design

The features of the front suspension design of the ZIL-131 are determined by the heavier load on its front axle. In connection with this, the number and thickness of the spring plates are increased in comparison to the suspension system of the ZIL-130. The springs of the vehicle equiped with a winch consist of 17 plates, and in a vehicle without a winch - of 15 plates 8 mm thick.

An additional attachment is installed to equalize the thickness of plates on vehicles without a winch.

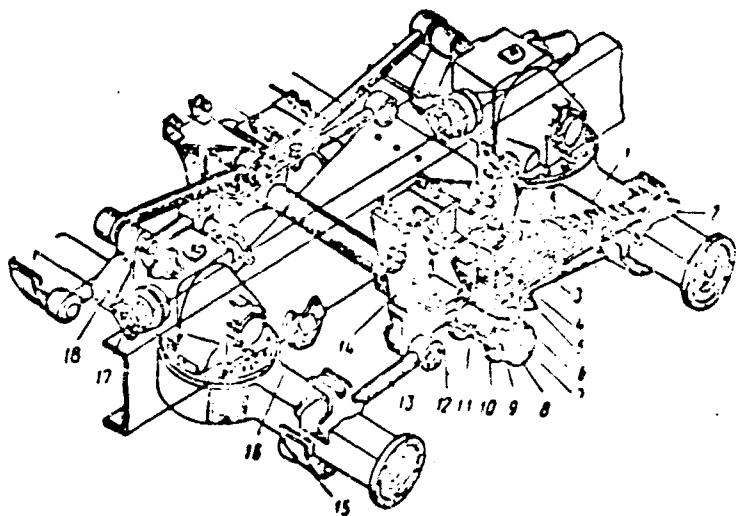
Attachment of the springs to the front axle has the following differences.

blocks with which the axle is fixed relative to the springs are installed between the springs and axles.

The spring flanges are placed in the openings of the blocks, and the latter are restrained on the axle beam from longitudinal displacements by their own closed ends, and from lateral displacements - by lugs welded to the beam.

The spring stirrups are positioned on a slant, and their blocks are poured from wrought iron. The left block has a rib underneath, designed to protect the crosstie rod which sticks out from behind the beam from damage by objects encountered on the highway. The stirrup blocks are not symmetrical and one must be guided by inscriptions cast on the lower surfaces of the blocks when installing them on the vehicle.

The shock absorbers of the ZIL-131 are longer and have a greater stroke than those of the ZIL-130, due to the large displacements of the axel.



#### Rear Suspension:

- 1- spring; 2-rear spring support; 3-spring cover plate;
- 4- stirrup; 5- clamp stud; 6- lubricant filler plug;
- 7- tie bolt; 8- hub cover; 9- split nut; 10-balance suspension axel; 11- hub; 12- balance suspension axel bracket;
- 13- reaction rod; 14- bracket for attaching rear suspension to chassis; 15- lower reaction lever; 16- rubber buffer;
- 17- bolt for securing the pins of the reaction rods;
- 18- upper reaction lever.

The rear springs (1) - See sketch - of the ZIL-131 are made from the same rolled iron as those of the ZIL-157K (cross section of 11 x 63 mm), but they have a greater number of plates (15) and are longer. In connection with this, the stirrups (4) of the rear springs are lengthened. A spacer plate (19) which increases the life of the main plate, and a cover plate which protects the hub from warping by the spring plugs are installed between the spring and hub of the balance suspension. The rear spring supports (2), as do the reaction levers (15 and 18), differ from similar components of the ZIL-157K by the shape of the

surfaces adjoining the axel beams. The rubber buffers (16) of the rear axels have a greater amount of rubber to increase their life.

#### The Balance Suspension

The balance suspension axel pin is straight (10), is fitted into the brackets (12), which are poured from wrought iron. The chassis linkage brackets (14) are also poured from wrought iron and are attached to the axel brackets with bolts. The hubs (11) of the balance suspension have reinforced flanges for attaching the springs.

The hub is attached to the axel by a slit nut (9) coupled by bolt (7) with a self-locking nut. Such a nut fixed on the axel is more reliable than the assembly consisting of a nut-washer, lock-nut and lock plates used on the ZIL-157K.

The reactive rods are longer and their lugs are elongated cones which increase the reliability of the coupling to the brackets and reactive levers.

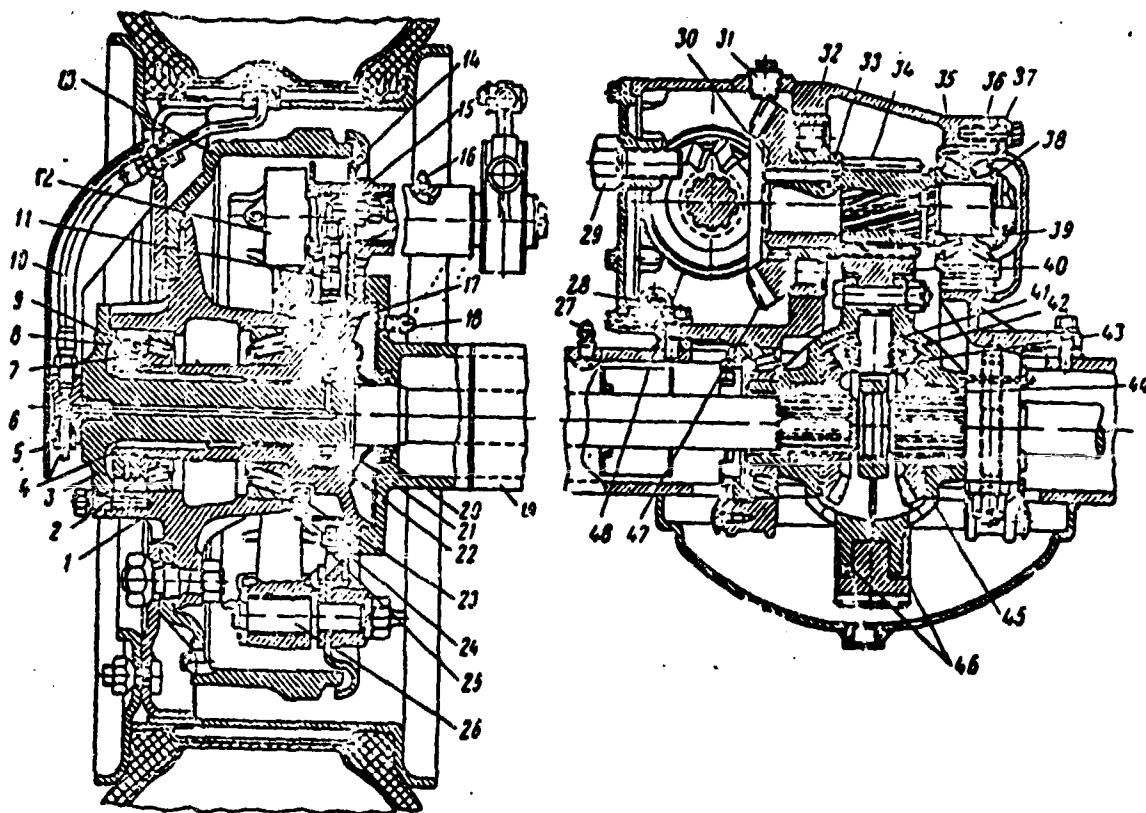
The upper reactive rods are attached to the right bracket of the rear suspension, which facilitates assembly and disassembly of the rear carriage.

L. Grinshteyn

#### The Axels

The rear and front rear axels of the ZIL-131 are the driving axels. The front axel is a driving and steering axel.

All the axel housings are welded from two halves. The housing halves are stamped from sheet steel. The housings (19) - Fig. 1 - of the rear and front rear axels are identical, and their metal flanges designed to brace the reducing gears are positioned horizontally. Detachable journals (4) are attached to the end flanges. The upper and lower reactive lever brackets and the supports for the spring ends of the rear balancing suspension are welded to the housings of the rear and front rear axels.



**Rear and Front Rear Axels with Brakes:**

- 1- hub; 2 and 25- hub bearings; 3- axel shaft; 4- journal;
- 5- clutch cover; 6- tire valve; 7- locking nut; 8- hub bearing screw; 9- block washer; 10- tire inflator hose;
- 11- cap air intake hose; 12- brake expansion cam; 13- brake drum; 14- brake discs; 15- brake support; 16- lubricating valve; 17- connecting pipe; 18 and 27- safety valves (breathers); 19- axel housing; 20- shaft seal; 21- protective sleeve; 22- air intake cap; 23 and 24- hub seals; 26- brake shoe axel; 28- overflow plug; 29- bolt for tightening reactive rod plug; 30- cotter; 31- inspection hole cover; 32- cylindrical roller bearing; 33- spacing ring; 34- cylindrical main drive pinion; 35- bearing seat; 36- adjustable shims of driven bevel pinion; 37- bearing housing; 38- dual conical roller bearing; 39- spacing bushing; 40- driven cylindrical pinion; 41- planet pinion support washer; 42- planet pinion; 43- differential center cross axel shaft pinion; 45- axel shaft pinion support washer; 46- differential cup; 47- driven bevel gear; 48- driving bevel gear.

The metal housing flange of the front axel is positioned vertically. The rolling cam ball supports are attached to the end flanges of the housing. All the axel shafts are balanced, the right shafts being longer than the left. Ball joints of fixed angular speed are installed in the front axel.

All axels of the ZIL-131 are equipt with a device to pump air into the tires from a centralized tire pressure control system.

The air intake caps (22), positioned inside the journals (4), are mounted on the axel shaft journals (3) of the rear and front rear axels (See Fig. 1). Air from the pressure control system is fed through the connecting pipe (17) into the space between the rubber colars of the air intake can (22), then into the axel shaft air inlet (3) tire valve (5) and through hose (10) to the chamber valve. The tire valves (6) mounted on the axel shaft flanges make it possible to disconnect each tire from the air pressure control system. Valves are not installed in the tires themselves when the air pressure control system is mounted on the vehicle. Air valves (breathers) (18) are mounted in the end flanges of the housing. Air may escape through these valves when the air intake cap does not work; otherwise, the air may force the lubricant into the brake, causing it to malfunction.

The air intake caps of the front axel are mounted on the car journals of the shaft universal joint, which is equipt with an air intake. The air intake device to the tires of the front and rear axels is basically identical.

The main transmissions of all axels are dual, consisting of a pair of spiral bevel gears (gear ratio of 1727) and a pair of skew cylindrical gears (gear ratio of 4250). Overall gear ratio of the transmission is 7339.

The driven bevel gear (47) of the rear and front rear axel transmissions is mounted at an angle on the shaft of the cylindrical drive gear (34), and the cylindrical driven gear (40) with its differential is positioned under the cylindrical drive gear. This made it possible to make the shaft (6) - Fig. 2 - of the bevel drive gear "straight", that is, with leads front and back of the front rear axel transmission. Torque from the transfer case of the vehicle

is fed to flange (15) mounted on the front end of the shaft of the front rear axle bevel drive gear. Torque is fed from flange (17), mounted on the rear end of the shaft, through the intermediate drive shaft to flange (2) on the front of the shaft of the rear axle bevel drive gear.

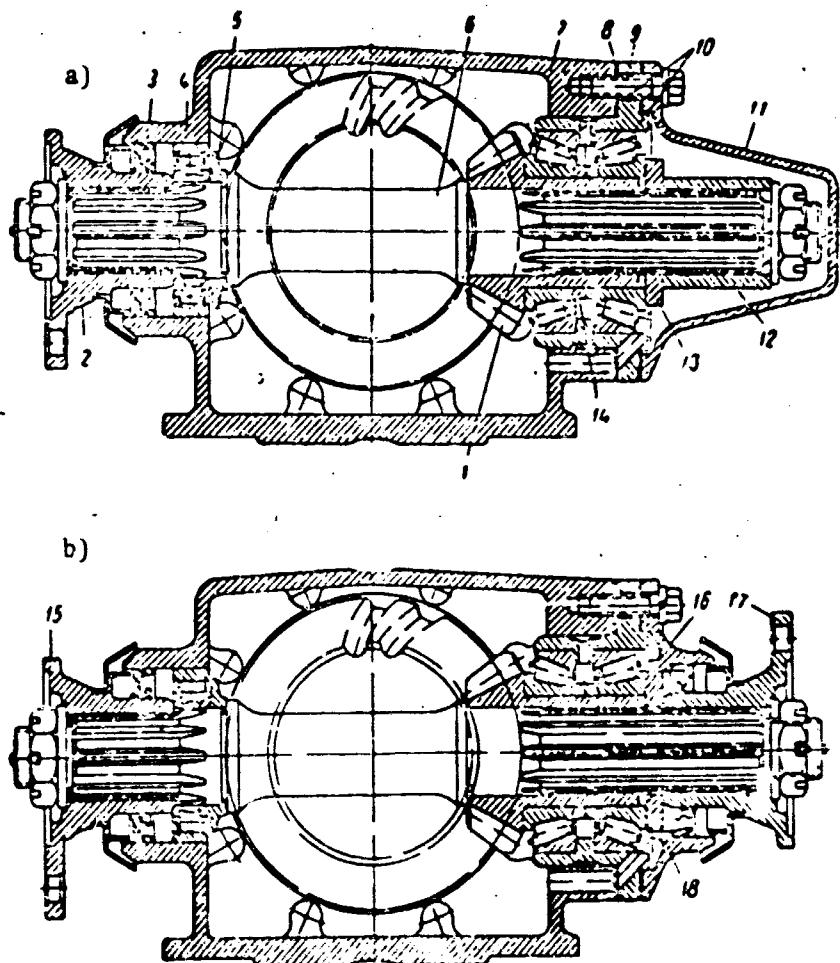


Fig. 2 - Rear and Front Rear Axel Reducing Gears:  
a- rear axel; 6- front rear axel;

1-bevel drive gear; 2, 15 and 17- shaft mounting flanges;  
3-seal; 4-cylindrical roller bearing; 5- spacing sleeve;  
6-bevel drive gear shaft; 7-reducing gear housing; 8-adjustable shims of the bevel drive gear; 9- bearing socket;  
10-conical roller bearings; 11-housing; 12-spacing sleeve;  
13-collar; 14-adjustable rings; 16-bearing housing; 18-thrust collar with oil-elimination slot.

All three reducing gears are maximally unitized among themselves.

The rear axle reducing gear differs from the front rear axle reducing gear in the following manner: Flange (15) of the front end and of the front rear axle reducing gear shaft is larger than flange (17) of the rear axle shaft. Flange (2) of the front end of the rear axle reducing gear shaft is identical in size to flange (17) of the front rear axle reducing gear, and a spacing sleeve (12) is mounted on the rear end of the rear axle reducing gear shaft instead of a flange. External conical roller bearing(10) of the bevel drive gear of the front rear axle reducing gear is imposed by a housing (16) with a seal installed in it, and the rear end of the rear axle reducing gear shaft is covered by a fixed housing (11). Bearing washer (18) of the front rear axle reducing gear bearing is equipt with an oil-elimination outlet with a clockwise spiral and has the imprint "3" on the butplate, and washer (13) of the rear axle reducing gear bearing has no oil-elimination outlet and imprint. Housing (9) of the front axle reducing gear (Fig. 3), shaft (26) of the bevel drive gear and cylindrical roller bearing (31) of the inner end of the shaft differ from similar components of rear and front rear axle drive gears. Supporting collar (23) of the outer bearing of the bevel drive gear has an oil-elimination outlet with a counter-clockwise spiral and the imprint F.

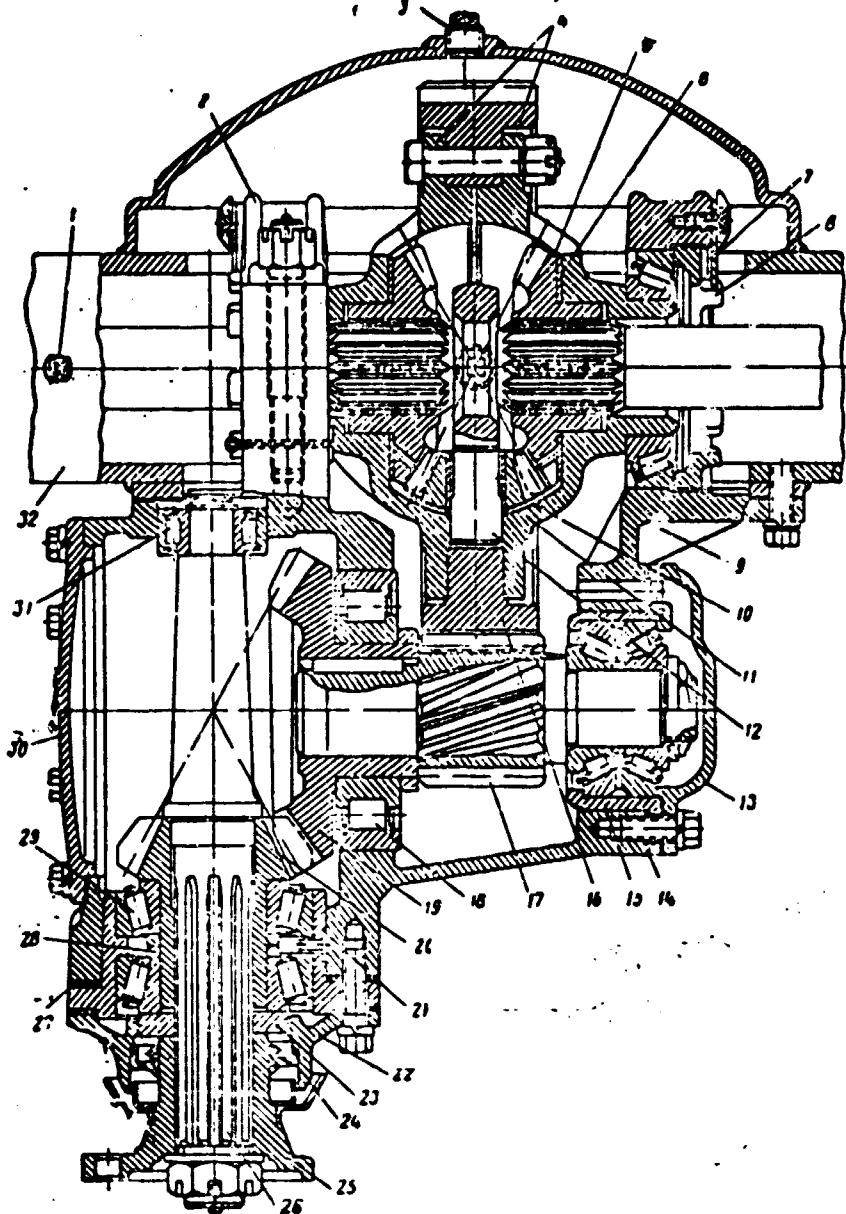


Fig. 3- Reducing Gear of the Front Axle with Differential:  
 1-safety valve (breather); 2-differential bearing housing;  
 3-control plug; 4-differential sockets; 5-axle shaft gear;  
 6-supporting collar of axle shaft gear; 7-locking device;  
 8-adjustable nuts; 9-reducing gear housing; 10-satellite gear;  
 11-satellite gear supporting collar; 12-differential center  
 cross; 13-housing; 14-adjustable shims of driven conical gear;  
 15-bearing socket; 16-cylindrical driven gear; 17-cylindrical

drive gear; 18 and 31- cylindrical roller bearing; 19- conical driven gear; 20-conical drive gear; 21-bearing socket; 22-bearing housing; 23-oil-elimination washer; 24- seal; 25-drive shaft attachment flange; 26- conical drive gear shaft; 27- adjustable shims of conical drive gear; 28-adjustable rings; 29-conical roller bearing; 30- reducing gear housing cover; 32- axel housing;

Cover (22) of this bearing is identical to the bearing cover of the front rear axel reducing gear. Flange (25) of the conical drive gear shaft is identical to that of the rear axel reducing gear shaft.

Covering(13) of the two-roll bearing of the cylindrical drive and conical driven shafts are similar to the covering of the rear and front rear axel reducing gears, but it has an additional hole with a fraction  $1/8"$  conical thread, in which a plug is installed. This plug is used to close the oil-overflow vent of the vehicles clutch housing when fording streams.

The reducing gear housings of all axels have inspection holes on top, closed by threaded plugs (31) - See Fig. 1 - The inspection holes permit checking the condition of the cogs and the accuracy of the contact point ofthe conical gears without disassembling the reducing gear.

These holes are also used to pour oil into the rear and front rear axel housings. Oil is poured in until it begins to flow through the open control oil and the housing cover.

Such positioning of the control hole of the rear and front rear axels makes it possible to use it only to pour oil into the housing. If it became necessary during operation to check oil level in the housing, a special oil level indicator in the set of driver's tools would have to be used. In order to check the oil level, the rear bolt attaching the reducing gear to the axel housing must be unscrewed and the oil level indicator must be inserted into the bolt hole until its end rests against the reducing gear housing flange. The correct oil level is marked by a groove on the oil indicator dipstick. Oil must also be poured into the front of the housing (during change of lubricant) through the

upper inspection hole in the reducing gear housing until oil appears in the open control hole in the axel housing cover. Oil may be poured directly through the control hole. The rear and front rear axels have in addition to the overflow hole located underneath in the axel housing cover an additional overflow hole closed by plug (28) for drawing off oil from the upper compartment of the reducing gear housing (See Fig. 1). The lubricating valves located in the top cover plate of the right housing of the rolling cam and in the rolling arm of the left housing of the rolling cam are used to lubricate the upper bearings of the front axel king pins and to add oil to the ball bearing. Oil should be added until it appears from the open control hole in the lower part of the ball bearing.

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This article describes various design features of the  
ZIL-131 vehicle and compares them with those of the  
ZIL-130 and the ZIL-157K. The description includes the  
design differences of the power plant, drive shaft, suspension  
system, and the drive axles. The article contains five  
diagrams.

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